MySQL RDBMS

- MySQL is a database server (although it does come with a set of simple client programs). There are many different versions available. We’ll be using the Community Server. The current stable version is 5.6.11 and can be downloaded from www.mysql.com. The underlying MySQL Server for this version is currently 5.5.31.

- It is typically used in thin client environments. In other words, it is used in client-server systems where the bulk of the processing and storage takes place on the server, and the client is little more than a dumb terminal.

- MySQL performs multithreaded processing, which means that multiple clients are allowed to connect to it and run queries simultaneously. This makes MySQL extremely fast and well suited to client-server environments such as Web sites and other environments that process numerous transactions for multiple users.
Click here to go to download page
MySQL Cluster CGE (commercial)
MySQL Cluster is a real-time open source transactional database designed for fast, always-on access to data under high throughput conditions.
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- MySQL Cluster Manager
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Download from MySQL Developer Zone »
Scroll down this page and select the proper version for your system and a site to begin download. There will be a registration type form at the top of the page...you can ignore this if you wish and go straight to the download site.

We suggest that you use the MD5 checksums and GnuPG signature to verify the integrity of the packages you download.
Go back to the main download page and also download MySQL Workbench which contains the Administrator and MySQL Query Browser GUI tools.
Once again, go back to the main download page and select Connectors.
Download the Connector/J for use with Java applications.
Installing MySQL 5.6.11

• Once you’ve got MySQL downloaded, go through the installation process. It may vary somewhat depending on platform.

• I’ve illustrated the basic install on Windows 7 using the MSI (installer) over the next few pages, just to give you an idea of what you should be seeing.
Once the Window installer is running you should see the following window appear:

Click Next and accept the terms on the next window.

Installing MySQL 5.6.11

You’ll see slightly different output over the next few pages depending on the option you select here.
License Agreement

To install MySQL, you must accept the Oracle Software License Terms.

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Version 2, June 1991

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Preamble

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want it, that you can change the software or use pieces of it in new
free programs; and that you know you can do these things.

I accept the license terms

< Back  Next >  Cancel
Before the installation is performed, the Installer will check if there are newer versions of the products you are about to install / already installed are available.

- Connect to the Internet
- Fetch product update information

Product upgrades
- Upgrade MySQL Server 5.5.29 to MySQL Server 5.5.30

Skip the check for updates (not recommended)
Installing MySQL 5.6.11 (cont.)

Your choice here. For this course, a typical set-up will be fine.
Installing MySQL 5.6.11 (cont.)

Click Install
Installing MySQL 5.6.11 (cont.)

Please wait while the Setup Wizard installs MySQL Server 5.5.

Status:

MySQL Enterprise

A MySQL Enterprise subscription is the most comprehensive offering of MySQL database software, services, and support to ensure your business achieves the highest levels of reliability, security, and uptime.

An Enterprise Subscription includes:

1. The MySQL Enterprise Server - The most reliable, secure, and up-to-date version of the world's most popular open source database.
3. MySQL Production Support - Technical and consultative support when you need it, along with service packs, hot-fixes, and more.

For more information click [More...] or visit www.mysql.com/enterprise
Installing MySQL 5.6.11 (cont.)

Click Finish
Installing MySQL 5.6.11 (cont.)

Initial server configuration window
Installing MySQL 5.6.11 (cont.)

MySQL Server Instance Configuration Wizard

MySQL Server Instance Configuration
Choose the configuration for the server instance.

Please select a configuration type.

- **Detailed Configuration**
  Choose this configuration type to create the optimal server setup for this machine.

- **Standard Configuration**
  Use this only on machines that do not already have a MySQL server installation. This will use a general purpose configuration for the server that can be tuned manually.
Installing MySQL 5.6.11 (cont.)

Your choice here. If you are not sure if there is already a MySQL server on your machine, choose the detailed configuration setting.

If you already have an instance of a MySQL server on your machine, you’ll see this screen first, followed by the one above. Select reconfigure instance.
Installing MySQL 5.6.11 (cont.)

Choose the developer machine option.
Choose the multifunctional database option.
Choose the installation path to keep InnoDB tables in the same area as other MySQL files.
Installing MySQL 5.6.11 (cont.)

Select manual setting for this option. The default is 15, I set mine to 10, but you can use any number you would like, but pick something greater than 3 or 4.
Accept all defaults in this window
Installing MySQL 5.6.11 (cont.)

Your choice again
Installing MySQL 5.6.11 (cont.)

Accept default options

This option is not marked by default, but you can mark and accept it if you want to include MySQL file locations in your PATH statement.
Accept default setting and enter a password for the root (superuser with all privileges by default). Enabling root access from remote machines is only necessary if you will be accessing the DB as the root user from a remote machine – we will not be doing this in this course.

Do not enable this option

This option will create an anonymous account on this server. Please note that this can lead to an insecure system.
Configuration is about to begin. Now cross your fingers, toes, and anything else you have, take a deep breath, click the Execute button and close your eyes for a few seconds.

When they all have green check marks in them – you’re good to go!
Installing MySQL 5.6.11 (cont.)

You’ve successfully installed MySQL!!
Running MySQL 5.6.11

• If you’ve successfully installed MySQL, it should now be running as a service on your machine. It will start automatically when your machine boots.

• Go into your listing of programs (from the start menu at the bottom: All Programs) and you should see MySQL appear. Since you will be running MySQL clients a lot, it will be easier if you pin the MySQL 5.5 Command Line Client to the start menu.

• To verify that MySQL is running properly as a service you can either check the process window or run a MySQL client.
Hopefully, you see this output from MySQL. The MySQL server is now awaiting a command from this client.
List all databases managed by this MySQL server which are accessible to this client.

```
mysql> show databases;
+--------------------------+
| Database                 |
+--------------------------+
| information_schema       |
| mysql                    |
| performance_schema       |
| test                     |
+--------------------------+
4 rows in set (0.00 sec)

mysql>
```

Note: new installations will contain only 4 databases: information_schema, mysql, performance_schema, and test.
Terminate client connection.

List all databases managed by this MySQL server which are accessible to this client.
Specifying A Database Within MySQL

- Unless, it is specifically stated, in the following slides we’ll assume that the user has root-level privileges.

- To select a database for use in MySQL the `use` command must be issued. In the example below, we’ll select the `bikedb` database.

```
mysql> use bikedb;
Database changed
```
Viewing the Schema of a Relation

- To see the schema of a relation within a database, use the `describe <tablename>` command as illustrated below.

```sql
mysql> use bikedb;
Database changed
mysql> create table bikes (  
    -> bikename varchar(30) not null,  
    -> size int(2),  
    -> color varchar(15),  
    -> cost int(5),  
    -> purchased date,  
    -> mileage int(6),  
    -> primary key (bikename)  
    -> );
Query OK, 0 rows affected (0.10 sec)
mysql> describe bikes;
+ Field + Type     + Null + Key + Default + Extra 
+-------+-----------+------+------+----------+------- 
| bikename | varchar<30> | NO   | PRI  | NULL     | NULL  
| size     | int(2)     | YES  |      | NULL     | NULL  
| color    | varchar(15) | YES  |      | NULL     | NULL  
| cost     | int(5)     | YES  |      | NULL     | NULL  
| purchased| date       | YES  |      | NULL     | NULL  
| mileage  | int(6)     | YES  |      | NULL     | NULL  
6 rows in set (0.00 sec)
```

Specify which table’s schema to describe. All information regarding the schema visible to the user is displayed.
Viewing the Relations of a Database

- Once a database has been selected you can see the relations (tables) within that database with the `show tables` command as illustrated below.

Show tables command lists all the relations within a database visible to the user. There are two tables in this database.
Running a Simple Select Query in MySQL

- Within the MySQL monitor, running an SQL query is straightforward. The example below illustrates a simple selection query on the `bikes` table of the `bikedb` database.

```
mysql> select * from bikes;
```

<table>
<thead>
<tr>
<th>bikename</th>
<th>size</th>
<th>color</th>
<th>cost</th>
<th>purchased</th>
<th>mileage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battaglin Carrera</td>
<td>60</td>
<td>red/white</td>
<td>4000</td>
<td>2001-03-10</td>
<td>11200</td>
</tr>
<tr>
<td>Bianchi Corse Evo 4</td>
<td>58</td>
<td>celeste</td>
<td>5700</td>
<td>2001-03-10</td>
<td>3000</td>
</tr>
<tr>
<td>Bianchi Evolution 3</td>
<td>58</td>
<td>celeste</td>
<td>4800</td>
<td>2003-11-12</td>
<td>2000</td>
</tr>
<tr>
<td>Bianchi Infinito</td>
<td>58</td>
<td>celeste</td>
<td>8900</td>
<td>2011-07-14</td>
<td>0</td>
</tr>
<tr>
<td>BMC SLC01 - Swiss</td>
<td>58</td>
<td>red/black/white</td>
<td>8000</td>
<td>2010-06-23</td>
<td>0</td>
</tr>
<tr>
<td>Colnago Dream Rabobank</td>
<td>60</td>
<td>blue/orange</td>
<td>5500</td>
<td>2002-07-07</td>
<td>4300</td>
</tr>
<tr>
<td>Colnago Superissimo</td>
<td>59</td>
<td>red</td>
<td>3800</td>
<td>1996-03-01</td>
<td>13000</td>
</tr>
<tr>
<td>Eddy Merckx Domo</td>
<td>58</td>
<td>blue/black</td>
<td>5100</td>
<td>2004-08-12</td>
<td>0</td>
</tr>
<tr>
<td>Eddy Merckx Molteni</td>
<td>58</td>
<td>orange</td>
<td>5100</td>
<td>2004-08-12</td>
<td>0</td>
</tr>
<tr>
<td>Gianni Motta Personal</td>
<td>59</td>
<td>red/green</td>
<td>4400</td>
<td>2000-05-01</td>
<td>8700</td>
</tr>
<tr>
<td>Gios Torino Super</td>
<td>60</td>
<td>blue</td>
<td>2000</td>
<td>1998-11-08</td>
<td>9000</td>
</tr>
<tr>
<td>Ridley Danocles</td>
<td>58</td>
<td>blue/black</td>
<td>7500</td>
<td>2008-06-27</td>
<td>0</td>
</tr>
<tr>
<td>Ridley X-Fire</td>
<td>58</td>
<td>red/white</td>
<td>7500</td>
<td>2011-09-01</td>
<td>0</td>
</tr>
<tr>
<td>Schwinn Paramount P14</td>
<td>60</td>
<td>blue</td>
<td>1800</td>
<td>1992-03-01</td>
<td>200</td>
</tr>
</tbody>
</table>

14 rows in set (0.00 sec)
Creating a Database in MySQL

- From the MySQL monitor enter `create database <db name>`

```
mysql> show databases;
+----------------+
| Database       |
+----------------+
| information_schema | bikedb | colorsurvey | guestbook | mailinglist | mysql | performance_schema | prog3 | sample | test |
+----------------+
9 rows in set (0.00 sec)

mysql> create database sample;
Query OK, 1 row affected (0.00 sec)

mysql> show databases;
+----------------+
| Database       |
+----------------+
| information_schema | bikedb | colorsurvey | guestbook | mailinglist | mysql | performance_schema | prog3 | sample | test |
+----------------+
10 rows in set (0.00 sec)
```

Create new database from within MySQL monitor.

Subsequent listing shows newly created database.
Dropping a Database in MySQL

• From the MySQL monitor execute the `drop database <dbname>` command.

From within the MySQL monitor, no warning is given when dropping a database. Be very sure that this is what you want to do before you do it.
Manipulating Tables in MySQL

- The creation of a database does not place any relations into the database. Relations must be separately created.

- To create a table within a database, first select the database (or create one if you haven’t already done so), then execute the `create table` command.

```sql
mysql> use sample;
Database changed
mysql> create table articles (  
    -> article_id int(9) not null auto_increment,  
    -> headline text not null,  
    -> data_post datetime not null default '0000-00-00 00:00:00',  
    -> text_body text,  
    -> who_created int(9) default null,  
    -> email_sent int(1) not null default '0',  
    -> date_email datetime default null,  
    -> who_approved int(9) default null,  
    -> pic varchar(255) default null,  
    -> primary key (article_id)  
    -> );
Query OK, 0 rows affected (0.04 sec)
mysql>
```
Manipulating Tables in MySQL (cont.)

Screen shot that describes the newly created table.
Manipulating Tables in MySQL (cont.)

• The `create table` command has the following general format:

```sql
create [temporary] table
    [if not exists] tablename
    [(create_definition, ...)]
    [table_options] [select_statement];
```

• If the `[if not exists]` clause is present, MySQL will produce an error message if a table with the specified name already exists in the database, otherwise the table is created.
Manipulating Tables in MySQL (cont.)

• A temporary table exists only for the life of the current database connection. It is automatically destroyed when the connection is closed or dies.

• Two different connections can use the same name for a temporary table without conflicting with one another.

• Temporary tables are most useful when queries get complex and intermediate results become useful. Also, versions of MySQL earlier than version 4.1 do not have subselect capability and temporary tables are a convenient way to simulate subselect query results.

Note: Non-root users require special permission to be able to create temporary tables. These users must have the Create_tmp_tables privilege set in the user grant table. We’ll see more on this later.
Creating A Temporary Table From A Select Query

A SELECT query produces a result set which has been extracted from one or more tables. A table can be created with the results of this data using the create table command.

```
14 rows in set (0.00 sec)

mysql> create temporary table celestebikes
-> select *
-> from bikes
-> where color = "celeste";
Query OK, 3 rows affected (0.11 sec)
Records: 3  Duplicates: 0  Warnings: 0

mysql> show tables;
+----------------+
| Tables_in_bikedb |
+----------------+
| bikes          |
| bluebikes      |
+----------------+
2 rows in set (0.00 sec)

mysql> select * from celestebikes;
+---------+--------+--------+---------+----------+---------+--------+
| bikename| size   | color  | cost    | purchased| mileage |
|---------+--------+--------+---------+----------+---------+--------+
| Bianchi Corse Evo 4 | 58     | celeste| 5700    | 2004-12-02 | 300     |
| Bianchi Evolution 3 | 58     | celeste| 4800    | 2003-11-12 | 2000    |
| Bianchi Infinito    | 58     | celeste| 8900    | 2011-07-14 | 0       |
+---------+--------+--------+---------+----------+---------+--------+
3 rows in set (0.00 sec)
```

Notice that temporary tables do not appear in a table listing.
Manipulating Tables in MySQL (cont.)

• Recall that the `create table` command has the following general format:

```sql
create [temporary] table
[if not exists] tablename
[(create_definition, ...)]
[table_options]
[select_statement];
```

• The table options allow you to specify the MySQL table type. The table type can be anyone of the six types listed in the table on the next slide.
### Manipulating Tables in MySQL (cont.)

<table>
<thead>
<tr>
<th>Table Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISAM</td>
<td>MySQL’s original table handler</td>
</tr>
<tr>
<td>HEAP</td>
<td>The data for this table is only stored in memory</td>
</tr>
<tr>
<td>MyISAM</td>
<td>A binary portable table handler that has replaced ISAM</td>
</tr>
<tr>
<td>MERGE</td>
<td>A collection of MyISAM tables used as one table</td>
</tr>
<tr>
<td>BDB</td>
<td>Transaction-safe tables with page locking</td>
</tr>
<tr>
<td>InnoDB</td>
<td>Transaction-safe tables with row locking</td>
</tr>
</tbody>
</table>

**MySQL Table Types**

ISAM, HEAP, and MyISAM are available for MySQL versions 3.23.6 or later.
MERGE, BDB, and InnoDB are available for MySQL versions 4.0 and later.

Default table type is InnoDB for MySQL versions 5.5.20.x.
Altering A Table

• After a table has been created, it is possible to change the specifications of its schema. This is done through the alter table command:

```
alter table table_name action_list
```

– Note: Changing the schema of a table in a database is not something that is done very often once the database has been created. The time for altering the schema is during the design phase. Altering the schema of an operational database is a very dangerous thing.

• Multiple changes to the table can be made at the same time by separating actions with commas in the action_list.

• The possible attribute (column) actions that can be used are shown in the table on the following slide.
### Altering A Table (cont.)

<table>
<thead>
<tr>
<th>Action Syntax</th>
<th>Action Performed</th>
</tr>
</thead>
<tbody>
<tr>
<td>`add [column] column_declaration [first</td>
<td>after column_name]`</td>
</tr>
<tr>
<td>`alter [column] column_name {set default literal</td>
<td>drop default}`</td>
</tr>
<tr>
<td><code>change [column] column_name column_declaration</code></td>
<td>Modify column declaration with renaming of column</td>
</tr>
<tr>
<td><code>modify [column] column_declaration</code></td>
<td>Modify column declaration without renaming column</td>
</tr>
<tr>
<td><code>drop [column] column_name</code></td>
<td>Drop a column and all data contained within it.</td>
</tr>
<tr>
<td><code>rename [as] new_table_name</code></td>
<td>Rename a table</td>
</tr>
<tr>
<td><code>table_options</code></td>
<td>Change the table options</td>
</tr>
</tbody>
</table>

Actions performed by `alter table` (column related) command

`column_name` represents the current name of the column, `column_declaration` represents the new declaration, in the same format as if it were in a `create` command.
Altering A Table (cont.)

- The screen shot below shows an example of altering a table.

```
mysql> describe bikes;
+---------------------+-------+------+-----+----------------+---------+
| Field               | Type  | Null | Key | Default | Extra   |
|---------------------+-------+------+-----+----------------+---------|
| bikename            | varchar(30) | NO   | PRI | NULL    |         |
| size                | int(2) | YES  |     | NULL    |         |
| color               | varchar(15) | YES  |     | NULL    |         |
| cost                | int(6) | YES  |     | NULL    |         |
| purchased date      | date  | YES  |     | NULL    |         |
| mileage             | int(6) | YES  |     | NULL    |         |
+---------------------+-------+------+-----+----------------+---------+
6 rows in set (0.00 sec)
mysql> alter table bikes
   -> add column races_won int(3) default 0;
Query OK, 10 rows affected <0.05 sec
Records: 10 Duplicates: 0 Warnings: 0
mysql> describe bikes;
+---------------------+-------+------+-----+----------------+---------+
| Field               | Type  | Null | Key | Default | Extra   |
|---------------------+-------+------+-----+----------------+---------|
| bikename            | varchar(30) | NO   | PRI | NULL    |         |
| size                | int(2) | YES  |     | NULL    |         |
| color               | varchar(15) | YES  |     | NULL    |         |
| cost                | int(6) | YES  |     | NULL    |         |
| purchased date      | date  | YES  |     | NULL    |         |
| mileage             | int(6) | YES  |     | NULL    |         |
| races_won           | int(3) | YES  |     | 0       |         |
+---------------------+-------+------+-----+----------------+---------+
7 rows in set (0.00 sec)
mysql>
```

Schema of bikes before alteration

There are 10 rows affected because this table currently contains 10 tuples (rows) and the new attribute has been added to all rows.

Bikes table after the addition of a new column named races_won
Altering A Table (cont.)

- The screen shot below shows the tuples currently in the bikes table after the addition of the new attribute illustrating that all of the tuples have assumed the default value on the new attribute.

Every tuple in the table has the default value for the new attribute.
Altering A Table (cont.)

- The screen shot below illustrates dropping a column from a table.
- Note that in general, this type of operation may not always be allowed due to constraint violations.

The attribute `races_won` has been eliminated from the table.
Altering A Table (cont.)

• The screen shot below shows a more complicated example of altering a table.

```
mysql> alter table bikes
    -> add column lastoverhaul datetime after bikename,
    -> modify cost int(8),
    -> add column races_ridden int(3) after mileage;
Query OK, 10 rows affected (0.03 sec)
Records: 10  Duplicates: 0  Warnings: 0

mysql> describe bikes;
+----------------+-----------+--------+----------+----------+--------------+-------------------+
| Field          | Type      | Null   | Key      | Default  | Extra        | Bikes table after  |
|----------------|-----------|--------|----------|----------|--------------| the alteration     |
| bikename       | varchar<30>| NO     | PRI      | NULL     |              |                   |
| lastoverhaul   | datetime  | YES    |          | NULL     |              |                   |
| size           | int(2)    | YES    |          | NULL     |              |                   |
| color          | varchar<15>| YES    |          | NULL     |              |                   |
| cost           | int(8)    | YES    |          | NULL     |              |                   |
| purchased      | date      | YES    |          | NULL     |              |                   |
| mileage        | int(6)    | YES    |          | NULL     |              |                   |
| races_ridden   | int(3)    | YES    |          | NULL     |              |                   |
+----------------+-----------+--------+----------+----------+--------------+-------------------+
8 rows in set (0.00 sec)
mysql>
```
Inserting Data Into A Table

• Data can be entered into a MySQL table using either the insert or replace commands.

• The insert statement is the primary way of getting data into the database and has the following form:

Form 1

\[
\text{insert [low priority | delayed] [ignore] [into]table_name}
\]
\[
[set] \text{column_name}_1 = \text{expression}_1, \\
\text{column_name}_2 = \text{expression}_2, \ldots
\]

Form 2

\[
\text{insert [low priority | delayed] [ignore] [into]table_name}
\]
\[
[(\text{column_name},\ldots)]\text{values (expression,\ldots), (\ldots)…}
\]

Form 3

\[
\text{insert [low priority | delayed] [ignore] [into]table_name}
\]
\[
[(\text{column_name},\ldots)] \text{select…}
\]
Inserting Data Into A Table (cont.)

• Form 1 of the insert statement is the most verbose, but also the most common. The `set` clause explicitly names each column and states what value (evaluated from each `expression`) should be put into the table.

• Form 2 (insert values) requires just a comma separated list of the data. For each row inserted, each data value must correspond with a column. In other words, the number of values listed must match the number of columns and the order of the value list must be the same as the columns. (In form 1, the order is not critical since each column is named.)

• Form 3 is used to insert data into a table which is the result set of a `select` statement. This is similar to the temporary table example seen earlier in the notes.

• The following couple of pages give some examples of the different forms of the `insert` command.
### Examples: Inserting Data Into A Table

Using Form 1 for insertion – attribute order is not important.

```sql
mysql> insert into bikes
   -> set bikename = "Eddy Merckx EM7",
   ->   cost=9500,
   ->   mileage=100,
   ->   purchased="2011-01-01",
   ->   color="red/white/blue",
   ->   size=58;
Query OK, 1 row affected (0.03 sec)

mysql> select * from bikes;
+-----------------+-----+----------+--------+-------------+----------+
| bikename        | size| color    | cost   | purchased   | mileage  |
|-----------------+-----+----------+--------+-------------+----------|
| Battaglin Carrera| 60  | red/white| 4000   | 2001-03-10  | 11200    |
| Bianchi Corse Evo 4 | 58  | celeste  | 5700   | 2004-12-02  | 300      |
| Bianchi Evolution 3 | 58  | celeste  | 4800   | 2003-11-12  | 2000     |
| Bianchi Infinito | 58  | celeste  | 8900   | 2011-07-14  | 0        |
| BMC SL01 - Swiss | 58  | red/white| 8000   | 2010-06-23  | 0        |
| Colnago Dream Rabobank | 60  | blue/orange| 5500  | 2002-07-07  | 4300     |
| Colnago Superissimo | 59  | red      | 3800   | 1996-03-01  | 13000    |
| Eddy Merckx Domo | 58  | blue/black| 5300  | 2004-02-02  | 0        |
| Eddy Merckx Molteni | 58  | orange   | 5100   | 2004-08-12  | 0        |
| Gianni Motta Personal | 59  | red/green| 4400   | 2000-05-01  | 8700     |
| Gios Torino Super | 60  | blue     | 2000   | 1998-11-08  | 9000     |
| Ridley Damocles | 58  | blue/black| 7500  | 2008-06-27  | 0        |
| Ridley X-Fire | 58  | red/white| 7500   | 2011-09-01  | 0        |
| Schwinn Paramount P14 | 60  | blue     | 1800   | 1992-03-01  | 200      |
+-----------------+-----+----------+--------+-------------+----------+
15 rows in set (0.00 sec)
```
Using Form 2 for insertion – attribute order is important.
Examples: Inserting Data Into A Table

```
mysql>
mysql>
mysql> create table celestebikes like bikes;
Query OK, 0 rows affected (0.11 sec)

mysql> select * from celestebikes;
Empty set (0.00 sec)

mysql> insert into celestebikes
   -> select *
   -> from bikes
   -> where color = "celeste";
Query OK, 3 rows affected (0.05 sec)
Records: 3 Duplicates: 0 Warnings: 0

mysql> select * from celestebikes;
+---------------+---+------+-----+------------+-------+
<table>
<thead>
<tr>
<th>bike name</th>
<th>size</th>
<th>color</th>
<th>cost</th>
<th>purchased</th>
<th>mileage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bianchi Corse Evo 4</td>
<td>58</td>
<td>celeste</td>
<td>5700</td>
<td>2004-12-02</td>
<td>300</td>
</tr>
<tr>
<td>Bianchi Evolution 3</td>
<td>58</td>
<td>celeste</td>
<td>4800</td>
<td>2003-11-12</td>
<td>2000</td>
</tr>
<tr>
<td>Bianchi Infinito</td>
<td>58</td>
<td>celeste</td>
<td>8900</td>
<td>2011-07-14</td>
<td>0</td>
</tr>
</tbody>
</table>
+---------------+---+------+-----+------------+-------+
3 rows in set (0.00 sec)
```

- Creates an initially empty table just like the bikes table.
- Table creation did not place any data into the table.
- Using Form 3 for insertion.
- This table contains the name and cost of those bikes whose color was celeste from the source table.
Examples: Inserting Data Into A Table

Create an initially empty table with a schema different from the base table.

Using Form 3 for insertion

This table contains the those bike tuples whose color was celeste from the source table.
Using Scripts with MySQL

• Entering data to create sample databases using conventional SQL commands is tedious and prone to errors. A much simpler technique is to use scripts. The following illustrates two techniques for invoking scripts in MySQL. The third and more preferable option is to use the MySQL Workbench tool (see page 98 and on.)

• Create your script file using the text editor of your choice.

• Comments in the SQL script files begin with a # symbol.

• In the script file example shown on the next slide, I drop the database in the first SQL command. Without the if exists clause, this will generate an error if the database does not exist. The first time the script executes (or subsequent executions if the database is dropped independently) the error will be generated…simply ignore the error.
Using Scripts with MySQL (cont.)

Drop the database if it already exists.

Create a new database.

Switch to the new database.

Define schema for the new table.

Insert some tuples

Run a simple selection query on the new table.

```sql
# SQL commands in a script file
drop database if exists testdb;
create database testdb;
use testdb;
create table states (name varchar(15) not null, abbrev char(2),
capital varchar(25), population integer,
square_miles integer, primary key (name))
;
insert into states values ('Florida', 'FL', 'Tallahassee', 18328240, 54153);
insert into states values ('New York', 'NY', 'Albany', 194909297, 54556);
insert into states values ('Indiana', 'IN', 'Indianapolis', 6376792, 35789);
insert into states values ('Maryland', 'MD', 'Annapolis', 5633597, 9975);
select * from states;
```
Using Scripts with MySQL (cont.)

```
mysql> source c:\state\script.sql
Query OK, 0 rows affected, 1 warning <0.00 sec>
Query OK, 1 row affected <0.00 sec>
Database changed
Query OK, 0 rows affected <0.10 sec>
Query OK, 1 row affected <0.05 sec>
Query OK, 1 row affected <0.05 sec>
Query OK, 1 row affected <0.06 sec>
Query OK, 1 row affected <0.06 sec>

+-----------------+-------+-----------------+-----------------+-----------------+-----------------+
<table>
<thead>
<tr>
<th>name</th>
<th>abbrev</th>
<th>capital</th>
<th>population</th>
<th>square_miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Florida</td>
<td>FL</td>
<td>Tallahassee</td>
<td>18328240</td>
<td>54153</td>
</tr>
<tr>
<td>Indiana</td>
<td>IN</td>
<td>Indianapolis</td>
<td>6376792</td>
<td>35789</td>
</tr>
<tr>
<td>Maryland</td>
<td>MD</td>
<td>Annapolis</td>
<td>5633597</td>
<td>9975</td>
</tr>
<tr>
<td>New York</td>
<td>NY</td>
<td>Albany</td>
<td>194909297</td>
<td>54556</td>
</tr>
</tbody>
</table>
+-----------------+-------+-----------------+-----------------+-----------------+
4 rows in set <0.00 sec>
```
Importing Data Using the `mysqlimport` Utility

- As with many things in MySQL there are several ways to accomplish a specific task. For getting data into tables, the `mysqlimport` utility is also useful.

- The `mysqlimport` utility reads a range of data formats, including comma- and tab-delimited, and inserts the data into a specified database table. The syntax for `mysqlimport` is:

  ```
  mysqlimport [options] database_name file1 file2 ...
  ```

- This utility is designed to be invoked from the command line.

- The name of the file (excluding the extension) must match the name of the database table into which the data import will occur. Failure to match names will result in an error.
Importing Data Using the \texttt{mysqlimport} Utility (cont.)

- The file shown below was created to import additional data into the \texttt{states} table within the \texttt{testdb} database used in the previous example.

- In this case, the default field delimiter (tab), default field enclosure (nothing), and the default line delimiter (\texttt{\textbackslash n}) were used. Many options are available and are illustrated in the table on pages 65-66.
Importing Data Using the `mysqlimport` Utility

Importing a “data file” into a MySQL database table using the `mysqlimport` utility

```
C:\Program Files\MySQL\MySQL Server 5.1\bin>mysqlimport -u root -vr testdb c:\states.txt
Connecting to localhost
Selecting database testdb
Loading data from SERVER file: c:\states.txt into states
testdb.states: Records: 4 Deleted: 0 Skipped: 0 Warnings: 3
Disconnecting from localhost
C:\Program Files\MySQL\MySQL Server 5.1\bin>
```

See tables on pages 23-24 for listing of options.

Table updated
Importing Data Using the `mysqlimport` Utility

Table **before** another client updated the table using the `mysqlimport` utility.

Table **after** another client updated the table using the `mysqlimport` utility.
## mysqlimport Utility Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>-r or --replace</td>
<td>Causes imported rows to overwrite existing rows if they have the same unique key value.</td>
</tr>
<tr>
<td>-i or --ignore</td>
<td>Ignores rows that have the same unique key value as existing rows.</td>
</tr>
<tr>
<td>-f or --force</td>
<td>Forces mysqlimport to continue inserting data even if errors are encountered.</td>
</tr>
<tr>
<td>-l or --lock</td>
<td>Lock each table before importing (a good idea in general and especially on a busy server).</td>
</tr>
<tr>
<td>-d or --delete</td>
<td>Empty the table before inserting data.</td>
</tr>
<tr>
<td>--fields-terminated-by='char'</td>
<td>Specify the separator used between values of the same row, default \t (tab).</td>
</tr>
<tr>
<td>--fields-enclosed-by='char'</td>
<td>Specify the delimiter that encloses each field, default is none.</td>
</tr>
</tbody>
</table>
### mysqlimport Utility Options (cont.)

<table>
<thead>
<tr>
<th>Option</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>--fields-optionally-enclosed-by='char'</td>
<td>Same as –fields-enclosed-by, but delimiter is used only to enclosed string-type columns, default is none.</td>
</tr>
<tr>
<td>--fields-escaped-by='char'</td>
<td>Specify the escape character placed before special characters; default is .</td>
</tr>
<tr>
<td>--lines-terminated-by='char'</td>
<td>Specify the separator used to terminate each row of data, default is \n (newline).</td>
</tr>
<tr>
<td>-u or –user</td>
<td>Specify your username</td>
</tr>
<tr>
<td>-p or –password</td>
<td>Specify your password</td>
</tr>
<tr>
<td>-h or –host</td>
<td>Import into MySQL on the named host; default is localhost.</td>
</tr>
<tr>
<td>-s or –silent</td>
<td>Silent mode, output appears only when errors occur.</td>
</tr>
<tr>
<td>-v or –verbose</td>
<td>Verbose mode, print more commentary on action.</td>
</tr>
<tr>
<td>-? or –help</td>
<td>Print help message and exit</td>
</tr>
</tbody>
</table>
Importing Data From A File With SQL Statement Load Data Infile

- Using the utility `mysqlimport` to load data into a table from an external file works well if the user has access to a command window or command line.

- If you have access via a connection to only the MySQL database, or you are importing data from within an executing application, you will need to use the SQL statement `Load Data Infile`.

- The `Load Data Infile` statement also provides a bit more flexibility since the file name does not need to match the table name. Other than that the options are basically the same and the same results are accomplished.

- The example on page 70 illustrates this SQL command which is available in MySQL.
Importing Data From A File With SQL Statement  

Load Data Infile (cont.)

- The basic form of the Load Data Infile statement is:

```
LOAD DATA [LOW_PRIORITY | CONCURRENT] [LOCAL] INFILE 'filename'
[REPLACE | IGNORE]
INTO TABLE tablename
[FIELDS
  [TERMINATED BY 'char']
  [OPTIONALLY] ENCLOSED BY 'char'
  [ESCAPED BY '\char']
][LINES
  [STARTING BY 'char']
  [TERMINATED BY 'char']
][IGNORE number LINES]
[(column_name, ...)]
```

- Either allow concurrent update or block until no other clients are reading from the specified table. See page 75.
- Same as –r and –i options in mysqlimport utility – either replace or ignore rows with duplicate keys.
- Sets the characters that delimit and enclose the fields and lines in the data file. Similar to mysqlimport syntax.
- Ignores lines at the start of the file (miss header info).
- Used to load only certain columns (not entire rows).
Load Data Infile Example

Text file containing the data to be loaded into the database table.

String fields may be enclosed by double quotes in this file. Numeric values are not enclosed in quotes.

Fields are delimited by commas and lines are terminated by newline characters (an invisible \n)
Load data infile statement indicating all of the parameters which describe the configuration of the input file.

States table before addition of data

States table after addition of data
Load Data Infile Example 2

Text file containing the data to be loaded into the database table.

California already exists in the states table – this one will replace the value of the capital with a different value.
Same basic configuration as in previous example except that we have instructed MySQL to replace duplicate key value rows with new values (in this case replacing California's capital).

States table before addition of data.

Same basic configuration as in previous example except that we have instructed MySQL to replace duplicate key value rows with new values (in this case replacing California's capital).

States table after addition of data. Note that California's capital has been changed!
The Ignore Clause of the Insert Command

• While the normal issues of data type compatibility are always of concern, there are other issues to deal with when inserting data into tables.

• There is the possibility that a duplicate of a key may be entered. If so, you will see an error like this:

    ERROR 1062: Duplicate entry ‘2’ for key 1

• It is possible to subdue errors by using the keyword ignore in the insert statement. By using ignore any duplicate rows will simply be ignored. They won’t be imported, and the data at the related row of the target table will be left untouched.

    – In your application, you would be wise to check how many rows were affected (imported) whenever using ignore because ignoring a record may constitute a failure condition in your application that needs to be handled.
Low Priority and Delayed Inserts

• If you specify `insert low-priority`, the insert waits until all other clients have finished reading from the table before the insert is executed.

• If you specify `insert delayed`, the client performing the action gets an instant acknowledgement that the insert has been performed, although in fact the data will only be inserted when the table is not in use by another thread.

  – This may be useful if you have an application that needs to complete its process in minimum time, or simply where there is no need for it to wait for the effect of an insert to take place. For example, when you’re adding data to a log or audit trail.

  – This feature applies only to ISAM or MyISAM type files.
Inserting/Replacing Data Using `Replace`

- Data can also be entered into a MySQL table using the `replace` command.
- The `replace` statement has forms similar to the `insert` statement:

  **Form 1**
  ```sql
  replace [low priority | delayed] [ignore] [into] `table_name`
  [set] `column_name1` = `expression1`,
  `column_name2` = `expression2`, ...
  ```

  **Form 2**
  ```sql
  replace [low priority | delayed] [ignore] [into] `table_name`
  [(`column_name`,...)]values (`expression`,...), (...)
  ```

  **Form 3**
  ```sql
  replace [low priority | delayed] [ignore] [into] `table_name`
  [(`column_name`,...)] select...
  ```
Using replace

• The replace statement works similar to insert. It always tries to insert the new data, but when it tries to insert a new row with the same primary or unique key as an existing row, it deletes the old row and replaces it with the new values.

• The following examples will illustrate how replace operates.

```
mysql> use bikedb;
Database changed
mysql> select * from bluebikes;
+------------------|---------|--------|--------+
<table>
<thead>
<tr>
<th>bikename</th>
<th>color</th>
<th>price</th>
<th>total_miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gios Torino Super</td>
<td>blue</td>
<td>2000</td>
<td>9000</td>
</tr>
<tr>
<td>Schwinn Paramount P14</td>
<td>blue</td>
<td>1800</td>
<td>200</td>
</tr>
</tbody>
</table>
+------------------|---------|--------|--------+
2 rows in set (0.00 sec)
mysql> replace into bluebikes
    -> values ('Gios Torino Super', 'blue', 4200, 11000);
Query OK, 2 rows affected (0.00 sec)
mysql> select * from bluebikes;
+------------------|---------|--------|--------+
<table>
<thead>
<tr>
<th>bikename</th>
<th>color</th>
<th>price</th>
<th>total_miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gios Torino Super</td>
<td>blue</td>
<td>4200</td>
<td>11000</td>
</tr>
<tr>
<td>Schwinn Paramount P14</td>
<td>blue</td>
<td>1800</td>
<td>200</td>
</tr>
</tbody>
</table>
+------------------|---------|--------|--------+
2 rows in set (0.00 sec)
mysql> 
```

Changing non-key values. Simplest form of data replacement.
Using Replace (cont.)

Specifying values for a non-existent key. Basically the same as an insert since the key value being replaced does not currently exist.
Performing Updates on Tables

- The `update` command allows you to modify the values of the existing data in a table. The basic format of the statement is:

  \[
  \text{update [low priority] [ignore] table_name}
  \]

  \[
  \text{set column_name1 = expression1,}
  \]

  \[
  \text{column_name2 = expression2, ...}
  \]

  \[
  \text{[where where_definition]}
  \]

  \[
  \text{[limit num]};
  \]

- There are basically two parts to the statement: the `set` portion to declare which column to set to what value; and the `where` portion, which defines which rows are to be affected.

- `Limit` restricts the number of rows affected to `num`. 
Using `update` (cont.)

Global update within the relation. All tuples have their price field increased by 5%.
Using `update` (cont.)

Specific update, only tuples satisfying the select condition (those with price greater than 4500) will have their price field increased by 5%.
Select Queries in MySQL

- The **select** command in MySQL is basically the same as in the standard SQL, however, it does have some additional features. The basic format of the statement is (not all options are shown – for complete details see the SQL Manual):

```
SELECT [ALL | DISTINCT | DISTINCTROW][HIGH_PRIORITY]
    [STRAIGHT_JOIN] [SQL_SMALL_RESULT][SQL_BIG_RESULT]
    [SQL_BUFFER_RESULT][SQ_CACHE | SQL_NO_CACHE]
    select_expression, ...
    [INTO {OUTFILE | DUMPFILE} 'path/to/filename' export_options]
    [FROM table_references
        WHERE where_definition]
    [GROUP BY {col_name | col_alias | col_pos | formula}
        [asc | desc], ...]
    [HAVING where_definition]
    [ORDER BY {col_name | col_alias | col_pos | formula}
        [asc | desc], ...]
    [LIMIT [offset, ] num_rows]
    [PROCEDURE procedure_name];
```
MySQL RDBMS (cont.)

- MySQL features a user permissions system, which allows control over user’s access to the databases under MySQL control.

- There are very few competitors of MySQL (Oracle, Sybase, DB2, and SQL Server) that can match the level of sophistication provided by MySQL’s permissions system in terms of granularity and level of security provided.

Note that I did not include Microsoft Access in the list above. There are a couple of reasons for this; Access concentrates on the client front-end, although available in shareable versions, it lacks the management system that is a key part of any RDBMS. Access provides virtually no user authentication capabilities nor does it have multithreading processing capabilities, in its normal form.
Authorization in MySQL

- `mysql` and the various utility programs such as `mysqladmin`, `mysqlshow`, and `mysqlimport` can only be invoked by a valid MySQL user.

- Permissions for various users are recorded in grant tables maintained by MySQL.

- As the root user, you have access to all the databases and tables maintained by the MySQL Server.

- One of these databases is named `mysql` and contains the various information on the users who have access to this installation of MySQL. Some of the tables which comprise this database are shown on the next few pages.
Tables in the MySQL Database

The mysql database contains user information

Details on user privileges at the database level. See page 94.

Specific details on privileges at the table level. See page 93

Details on user privileges. See page 91.

Details about the various users. See page 92.
### Contents of the `user` Table

```sql
mysql> use mysql;
Database changed
mysql> describe user;
```

<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Null</th>
<th>Key</th>
<th>Default</th>
<th>Extra</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host</td>
<td>varchar(60)</td>
<td></td>
<td>PRI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>User</td>
<td>varchar(16)</td>
<td></td>
<td>PRI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Password</td>
<td>varchar(41)</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Select_priv</td>
<td>enum('N','Y')</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insert_priv</td>
<td>enum('N','Y')</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Update_priv</td>
<td>enum('N','Y')</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delete_priv</td>
<td>enum('N','Y')</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Create_priv</td>
<td>enum('N','Y')</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drop_priv</td>
<td>enum('N','Y')</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reload_priv</td>
<td>enum('N','Y')</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shutdown_priv</td>
<td>enum('N','Y')</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process_priv</td>
<td>enum('N','Y')</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>File_priv</td>
<td>enum('N','Y')</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grant_priv</td>
<td>enum('N','Y')</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>References_priv</td>
<td>enum('N','Y')</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Index_priv</td>
<td>enum('N','Y')</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alter_priv</td>
<td>enum('N','Y')</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Show_db_priv</td>
<td>enum('N','Y')</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Super_priv</td>
<td>enum('N','Y')</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Create_tmp_table_priv</td>
<td>enum('N','Y')</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lock_tables_priv</td>
<td>enum('N','Y')</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Execute_priv</td>
<td>enum('N','Y')</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repl_slave_priv</td>
<td>enum('N','Y')</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repl_client_priv</td>
<td>enum('N','Y')</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ssl_type</td>
<td>enum('ANY','X509','SPECIFIED')</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ssl_cipher</td>
<td>blob</td>
<td></td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>x509_issuer</td>
<td>blob</td>
<td></td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>x509_subject</td>
<td>blob</td>
<td></td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>max_questions</td>
<td>int(11) unsigned</td>
<td></td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>max_updates</td>
<td>int(11) unsigned</td>
<td></td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>max_connections</td>
<td>int(11) unsigned</td>
<td></td>
<td></td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

31 rows in set (0.00 sec)
Contents of the `user_info` Table

```
mysql> describe user_info;
+----------+------------+------+-----+-----------------+-----+
| Field    | Type       | Null | Key | Default         | Extra|
|----------+------------+------+-----+-----------------+-----|
| User     | varchar(16)| NO   | PRI | NULL            |     |
| Full_name| varchar(60)| YES  | MUL | NULL            |     |
| Description| varchar(255)| YES |     | NULL            |     |
| Email    | varchar(80)| YES  |     | NULL            |     |
| Contact_information | text | YES  |     | NULL            |     |
| Icon     | blob       | YES  |     | NULL            |     |
+----------+------------+------+-----+-----------------+-----+
6 rows in set (0.02 sec)
mysql>
```
Contents of the `tables_priv` Table

```
mysql> \\
mysql> describe tables_priv;
+-------------------+--------------+
| Field             | Type         |
+-------------------+--------------+
| Host              | char(60)     |
| Db                | char(64)     |
| User              | char(16)     |
| Table_name        | char(64)     |
| Grantor           | char(77)     |
| Timestamp         | timestamp    |
| Table_priv        | set(Select,'Insert','Update','Delete','Create','Drop','Grant','References','Index', 'Column_priv | set(Select,'Insert','Update','References')
+-------------------+--------------+

8 rows in set (0.00 sec)
```

```
mysql> \\

<table>
<thead>
<tr>
<th>Field</th>
<th>Null</th>
<th>Key</th>
<th>Default</th>
<th>Extra</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>YES</td>
<td>PRI</td>
<td>PRI</td>
<td>CURRENT_TIMESTAMP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PRI</td>
<td>PRI</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PRI</td>
<td>MUL</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PRI</td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PRI</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```


Contents of the \texttt{db} Table

```sql
mysql> describe db;

+ Field         + Type     + Null + Key + Default + Extra +
+---------------+----------+-------+------+----------+--------+
| Host          | char(60) | NO    | PRI  |          |        |
| Db            | char(64) | NO    | PRI  |          |        |
| User          | char(16) | NO    | PRI  |          |        |
| Select_priv   | enum('N','Y') | NO | N    |          |        |
| Insert_priv   | enum('N','Y') | NO | N    |          |        |
| Update_priv   | enum('N','Y') | NO | N    |          |        |
| Delete_priv   | enum('N','Y') | NO | N    |          |        |
| Create_priv   | enum('N','Y') | NO | N    |          |        |
| Drop_priv     | enum('N','Y') | NO | N    |          |        |
| Grant_priv    | enum('N','Y') | NO | N    |          |        |
| References_priv| enum('N','Y') | NO | N    |          |        |
| Index_priv    | enum('N','Y') | NO | N    |          |        |
| Alter_priv    | enum('N','Y') | NO | N    |          |        |
| Create_tmp_table_priv | enum('N','Y') | NO | N    |          |        |
| Lock_tables_priv | enum('N','Y') | NO | N    |          |        |
| Create_view_priv | enum('N','Y') | NO | N    |          |        |
| Show_view_priv | enum('N','Y') | NO | N    |          |        |
| Create_routine_priv | enum('N','Y') | NO | N    |          |        |
| Alter_routine_priv | enum('N','Y') | NO | N    |          |        |
| Execute_priv  | enum('N','Y') | NO | N    |          |        |
| Event_priv    | enum('N','Y') | NO | N    |          |        |
| Trigger_priv  | enum('N','Y') | NO | N    |          |        |

22 rows in set (0.00 sec)
```

How The Grant Tables Work

• The various grant tables work together to define access capabilities for the various users of the databases in MySQL. The tables represent a hierarchy which begins at the database level and moves downward to finer and finer granularity in access capabilities.

• To understand how the grant tables work, it is necessary to understand the process that MySQL goes through when considering a request from a client.

**Step 1:** A user attempts to connect to the MySQL server. The user table is consulted, and on the basis of the username, password, and host from which the connection is occurring, the connection is either refused or accepted. (MySQL actually sorts the user table and looks for the first match.)
How The Grant Tables Work (cont.)

Step 2: If the connection is accepted, any privilege fields in the `user` table that are set to ‘Y’ will allow the user to perform that action on any database under the server’s control. For administrative actions such as shutdown and reload, the entry in the `user` table is deemed absolute, and no further grant tables are consulted.

Step 3: Where the user makes a database-related request and the `user` table does not allow the user to perform that operations (the privilege is set to ‘N’), MySQL consults the `db` table (see page 84).

Step 4: The `db` table is consulted to see if there is an entry for the user, database, and host. If there is a match, the `db` privilege fields determine whether the user can perform the request.
How The Grant Tables Work (cont.)

Step 5: If there is a match on the `db` table’s `Db` and `User` files but `Host` is blank, the `host` table is consulted to see whether there is a match on all three fields. If there is, the privilege fields in the `host` table will determine whether the user can perform the requested operation. Corresponding entries in the `db` and `host` tables must both be ‘Y’ for the request to be granted. Thus, an ‘N’ in either table will block the request.

Step 6: If the user’s request is not granted, MySQL checks the `tables_priv` (see page 83) and `columns_priv` tables. It looks for a match on the user, host, database, and table to which the request is made (and the column, if there is an entry in the `columns_priv` table). It adds any privileges it finds in these tables to the privileges already granted. The sum of these privileges determines if the request can be granted.
Managing User Privileges with GRANT and REVOKE

• The basic granting and revocation of privileges in MySQL are accomplished through the grant and revoke commands.

• The format of the grant command is:

```
GRANT privileges [(column_list)]
ON database_name.table_name
TO username@hostname [IDENTIFIED BY 'password']
[REQUIRE [SSL | X509]
 [CIPHER cipher [AND] ]
 [ISSUER issuer [AND] ]
 [SUBJECT subject ] ]
[WITH GRANT OPTION |
 MAX_QUERIES_PER_HOUR num |
 MAX_UPDATES_PER_HOUR num |
 MAX_CONNECTIONS_PER_HOUR num ]
```
### Some of the Privileges Assigned with GRANT

<table>
<thead>
<tr>
<th>Privilege</th>
<th>Operations Permitted</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALL or ALL PRIVILEGES</td>
<td>All privileges except for GRANT</td>
</tr>
<tr>
<td>ALTER</td>
<td>Change a table definition using ALTER TABLE excluding the creation and dropping of indices.</td>
</tr>
<tr>
<td>CREATE</td>
<td>Create database or tables within a database.</td>
</tr>
<tr>
<td>CREATE TEMPORARY TABLES</td>
<td>Create temporary tables.</td>
</tr>
<tr>
<td>DELETE</td>
<td>Ability to perform deletions from tables. (Delete DML statements).</td>
</tr>
<tr>
<td>DROP</td>
<td>Ability to drop databases or tables.</td>
</tr>
<tr>
<td>INSERT</td>
<td>Ability to insert data into tables.</td>
</tr>
<tr>
<td>SHUTDOWN</td>
<td>Ability to shutdown the MySQL server.</td>
</tr>
</tbody>
</table>
Displaying Privileges with \texttt{SHOW}

- The SQL command \texttt{SHOW} is used to display the grant privileges for a given user.
- The syntax for the \texttt{SHOW} command is:
  \begin{verbatim}
  SHOW GRANTS FOR username@hostname
  \end{verbatim}
- An example is shown below:

```sql
mysql> show grants for mark;
+----------------------------------------+
<table>
<thead>
<tr>
<th>Grants for mark@%</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRANT SELECT, INSERT, UPDATE, DELETE, CREATE ON <code>.*</code> TO `mark@%' IDENTIFIED BY PASSWORD 'E6ACCEDB2495496B191ED488F598F04239C85E73'</td>
</tr>
<tr>
<td>GRANT ALL PRIVILEGES ON <code>bikedb</code>.* TO `mark@%' WITH GRANT OPTION</td>
</tr>
</tbody>
</table>
+----------------------------------------+
2 rows in set (0.00 sec)
```
Revoking User Privileges with **REVOKE**

• Revocation of privileges in MySQL is accomplished with the `revoke` command.

• The format of the `revoke` command is:

  ```sql
  REVOKE privileges [(column_list)]
  ON database_name.table_name
  FROM username@hostname
  ```

• An example is shown on the next page.
Example - Revoking User Privileges with `REVOKE`

User has SELECT privilege on testdb.states table.

Revoking user's SELECT privilege on testdb.states.

User's grant listing shows that they no longer have SELECT privilege on testdb.states table.
The MySQL Workbench

- From MySQL you can download a GUI-based tool that allows you to create, manipulate, and administer MySQL databases.
- The current version of this tool (5.2.47) does not implement full functionality of the GRANT command down to the attribute level.
- This tool also contains some system administrator functionality for monitoring system resources and utilization.
- You can download this tool at: http://www.mysql.com/products/ (see page 7).
- The install/set-up for this tool as well as a few screen shots of this tool and its capabilities are shown in the next few slides.
The MySQL Workbench

MySQL Workbench requires the Visual C++ 2010 Redistributable Package to be installed. Click the Download-Button on the next page to open a web page containing further instructions. ATTENTION: 32bit version is required, regardless of your system type.
The MySQL Workbench

Click this button

MySQL Workbench 5.2 CE Setup Wizard

ended prematurely

The wizard was interrupted before MySQL Workbench 5.2 CE could be completely installed.

Your system has not been modified. To complete installation at another time, please run setup again.

Click Finish to exit the wizard.
Download and install both of these libraries – follow the onscreen prompts.
The MySQL Workbench
The MySQL Workbench

[Image of the MySQL Workbench setup wizard]

Destination Folder
Click Next to install to this folder, or click Change to install to a different folder.

Install MySQL Workbench 5.2 CE to:
C:\Program Files (x86)\MySQL\MySQL Workbench 5.2 CE

Change...
The MySQL Workbench

Setup Type
Choose the setup type that best suits your needs.

Please select a setup type.

- **Complete**
  All program features will be installed. (Requires the most disk space.)

- **Custom**
  Choose which program features you want installed and where they will be installed. Recommended for advanced users.
The MySQL Workbench

Ready to Install the Program

The wizard is ready to begin installation.

If you want to review or change any of your installation settings, click Back. Click Cancel to exit the wizard.

Current Settings:

Setup Type:
- Complete

Destination Folder:
C:\Program Files (x86)\MySQL\MySQL Workbench 5.2 CE\

< Back  Install  Cancel
The MySQL Workbench

Installing MySQL Workbench 5.2 CE

The program features you selected are being installed.

Please wait while the Setup Wizard installs MySQL Workbench 5.2 CE. This may take several minutes.

Status:
Copying new files
The MySQL Workbench

Wizard Completed

Setup has finished installing MySQL Workbench 5.2 CE.

Launch MySQL Workbench now

Finish

Cancel
```sql
# Script file for creating the bikedb that is used in many of the examples for the CNT 4714 notes

drop database if exists bikedb;
create database bikedb;
use bikedb;

create table bikes (  
    bikename varchar(30) not null,  
    size int(2),  
    color varchar(15),  
    cost int(6),  
    purchased date,  
    mileage int(6),  
    primary key (bikename)
);

insert into bikes values ('Colnago Dream Rabobank', 60, 'blue/orange');
insert into bikes values ('Bianchi Evolution 3', 58, 'celeste', 480);
insert into bikes values ('Eddy Merckx Molteni', 58, 'orange', 510);
insert into bikes values ('Eddy Merckx Domo', 58, 'blue/black', 536);
insert into bikes values ('Battaglin Carrera', 60, 'red/white', 400);
insert into bikes values ('Gianni Motta Personal', 59, 'red/green', 358);
insert into bikes values ('Gios Torino Super', 60, 'blue', 2000, '15');
insert into bikes values ('Schwinn Paramount P14', 60, 'blue', 1806);
```
### SQL Query
```
select * from bikes
```

### Bike Table
<table>
<thead>
<tr>
<th>bikename</th>
<th>size</th>
<th>color</th>
<th>cost</th>
<th>purchased</th>
<th>mileage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battaglin Carrera</td>
<td>60</td>
<td>red/white</td>
<td>4000</td>
<td>2001-03-10</td>
<td>11200</td>
</tr>
<tr>
<td>Bianchi Corse Evo 4</td>
<td>58</td>
<td>celeste</td>
<td>5700</td>
<td>2004-12-02</td>
<td>300</td>
</tr>
<tr>
<td>Bianchi Evolution 3</td>
<td>58</td>
<td>celeste</td>
<td>4800</td>
<td>2003-11-12</td>
<td>2000</td>
</tr>
<tr>
<td>Bianchi Infinito</td>
<td>58</td>
<td>celeste</td>
<td>8900</td>
<td>2011-07-14</td>
<td>0</td>
</tr>
<tr>
<td>BMC SLC01 - Swiss</td>
<td>58</td>
<td>red/bla...</td>
<td>8000</td>
<td>2010-06-23</td>
<td>0</td>
</tr>
<tr>
<td>Colnago Dream R...</td>
<td>60</td>
<td>blue/or...</td>
<td>5500</td>
<td>2002-07-07</td>
<td>4300</td>
</tr>
<tr>
<td>Colnago Superissi...</td>
<td>59</td>
<td>red</td>
<td>3800</td>
<td>1996-03-01</td>
<td>13000</td>
</tr>
<tr>
<td>Eddy Merckx Domo</td>
<td>58</td>
<td>blue/bl...</td>
<td>5300</td>
<td>2004-02-02</td>
<td>0</td>
</tr>
<tr>
<td>Eddy Merckx Molt...</td>
<td>59</td>
<td>orange</td>
<td>5100</td>
<td>2004-08-12</td>
<td>0</td>
</tr>
<tr>
<td>Gianni Motta Pers...</td>
<td>59</td>
<td>red/green</td>
<td>4400</td>
<td>2000-05-01</td>
<td>8700</td>
</tr>
<tr>
<td>Gios Torino Super</td>
<td>60</td>
<td>blue</td>
<td>2000</td>
<td>1998-11-08</td>
<td>9000</td>
</tr>
<tr>
<td>Ridley Damocles</td>
<td>58</td>
<td>blue/bl...</td>
<td>7500</td>
<td>2008-06-27</td>
<td>0</td>
</tr>
<tr>
<td>Ridley X-Fire 2012</td>
<td>58</td>
<td>red/white</td>
<td>7500</td>
<td>2011-09-01</td>
<td>0</td>
</tr>
</tbody>
</table>